

## **Integrating Marapu Indigenous Philosophy and Digital Innovation into the Mathematics Curriculum for Junior High Schools in Southwest Sumba**

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**Abstract:** This study aims to develop and test a culturally responsive mathematics curriculum through the integration of Marapu Philosophy and digital innovation to support sustainable education in junior high schools in Southwest Sumba. Theoretically, it is grounded in an ethnomathematics framework, which views mathematical practices as embedded in cultural activities; the Technological Pedagogical Content Knowledge (TPACK) framework; and multimedia learning theory to explain how technology – particularly Artificial Intelligence (AI) – acts as a cultural mediator in building conceptual understanding. A Design-Based Research (DBR) approach was chosen because it allows iterative, collaborative, and cyclical curriculum development in authentic school contexts, while the ASSURE model was used at the lesson-unit level to design systematic and operational teaching scenarios. The study involved 380 students and 76 teachers from 38 junior high schools, with traditional leaders serving as validators of cultural values. Qualitative data were collected through semi-structured interviews, structured classroom observations, and documentation of teaching materials, then analyzed using software-assisted thematic analysis with stepwise coding and checks of inter-coder reliability. Quantitative data were obtained from Likert-scale questionnaires and conceptual understanding tests (pre-post), and analyzed descriptively (percentages, means, and score differences). The results show increases in learning motivation (81.6%), conceptual understanding (77.6%), cultural identity (85.5%), and digital literacy (73.7%). The use of Canva AI, ChatGPT, and Khanmigo enriched learning experiences and strengthened pedagogical implications and curriculum policy based on the synergy between local wisdom and technology.

**Keywords:** Digital Innovation, Marapu Indigenous Philosophy, Mathematics Curriculum

## **A. Introduction**

Education in the era of globalization is required to balance two major agendas: responding to the rapid advancement of science and technology while simultaneously preserving the continuity of local cultural identity (Adeo et al., 2024). Changes in curriculum, instructional methods, and student competency targets are increasingly directed toward strengthening digital literacy and 21st-century skills (Bitu et al., 2024). However, an orientation that places excessive emphasis on modernization risks distancing learners from their own cultural roots, even though local wisdom holds great potential to enrich learning experiences and character formation (A. P. Setiawi, Edwin, et al., 2025).

In this context, the integration of local culture into mathematics instruction becomes a strategic issue that has not yet been fully addressed at the practical level. In Southwest Sumba Regency, Marapu Philosophy plays a central role in social life, ritual practices, and the community's worldview of nature. This philosophy is rich in values of harmony, balance, order, and numerical symbolism that, in fact, are closely related to mathematical concepts. Nevertheless, studies that systematically map how Marapu values can serve as a pedagogical foundation for bridging mathematical abstraction with students' cultural realities particularly at the junior high school level remain very limited (A. Setiawi et al., 2025; Soeriadiredja, 2013).

Theoretically, this study is grounded in the ethnomathematics framework, which emphasizes that mathematical practices are embedded within cultural activities and the ways of life of particular communities (D'Ambrosio, 1985; Habibi, 2025; Khaerani et al., 2024). From an ethnomathematical perspective, woven patterns, carvings on traditional houses, traditional calendrical systems, and rituals are regarded as legitimate mathematical representations that are meaningful for learners. In this study, ethnomathematics is employed to interpret Marapu Philosophy as a source of contexts, symbols, and structures of thinking that can be integrated into mathematical topics such as geometry, number patterns, logic, and measurement (Wulandari & Puspawati, 2016).

This ethnomathematical framework is further developed by integrating the Technological Pedagogical Content Knowledge (TPACK) framework, which highlights the importance of the intersection between content knowledge, pedagogical knowledge, and technological knowledge in designing effective instruction (Mishra & Koehler, 2006; Jayantika & Namur, 2022; Susanti et al., 2024). In the context of this study, content refers to junior high school mathematics concepts, pedagogy to contextual teaching strategies based on Marapu culture, and technology to the utilization of digital innovations and Artificial Intelligence (AI)-based applications such as Canva AI, ChatGPT, and Khanmigo. By combining ethnomathematics and TPACK, this research explores how Marapu cultural knowledge, pedagogical

strategies, and digital technologies can mutually reinforce one another within a coherent curriculum design.

The digital transformation of education opens concrete opportunities for such integration. Interactive media, e-modules, and AI-based platforms enable teachers to visualize cultural patterns in more engaging ways and to provide adaptive and personalized learning experiences (Ashari et al., 2025; Bito & Masaong, 2023; Setiawi, Mau, Sabawaly, et al., 2024). Canva AI, for instance, can be used to design visual media based on Sumba weaving and carvings; ChatGPT can function as a virtual tutor within blended learning scenarios; and Khanmigo offers adaptive mathematics problems that can be contextualized using numerical symbolism in Marapu. This approach aligns with the agenda of sustainable education, which targets not only academic achievement but also cultural preservation and the strengthening of digital literacy (A. P. Setiawi, 2024; Rahmi et al., 2024).

The novelty of this study lies in the explicit integration of three dimensions: (1) Marapu Philosophy as an ethnomathematical foundation, (2) the junior high school mathematics curriculum and instruction, and (3) the use of AI-based digital innovation as a pedagogical lever. Whereas culture-oriented and technology-oriented approaches are often positioned as if they occupy two opposing poles, this study seeks instead to construct a curriculum model that places them in a mutually complementary relationship (A. P. Setiawi, Bito, et al., 2025; Setiawi, Ayu, & Malo, 2025). By involving 38 schools across four districts (Kodi, Kodi Balaghar, Kodi Utara, and Kodi Bangedo), the research is expected to generate a comprehensive picture of the opportunities and challenges associated with implementing a culturally responsive and digitally oriented mathematics curriculum.

The expected contributions are both conceptual and practical. Conceptually, this study offers an ethnomathematics-TPACK integration framework that can serve as a reference for developing mathematics curricula based on local wisdom in diverse contexts (Asmara et al., 2024). Practically, the findings are expected to provide guidance for teachers, curriculum developers, and policymakers in designing instructional strategies, media, and school policies that balance tradition and modernity (Abdul Malik, 2024; Anita et al., 2025).

## **B. Methods**

### **1. Research Design and DBR-ASSURE Integratio**

This study was designed using a Design-Based Research (DBR) approach combined with the ASSURE instructional design model at the lesson-unit level. DBR was selected because it enables iterative development and testing of the curriculum within authentic school contexts through collaboration among researchers, teachers, and

traditional leaders, whereas the ASSURE model was employed to design concrete classroom learning scenarios in each implementation cycle (Asmara et al., 2024; Halimah et al., 2025). The following table summarizes the role of each framework and how the two are integrated in this study.

**Table 1. Research Design and DBR-ASSURE Integration**

<b>Aspect</b>	<b>Description</b>
Main approach	Design-Based Research (DBR) is employed to develop and test the effectiveness of the curriculum in authentic school contexts through repeated cycles of design-implementation-evaluation-revision (Asmara et al., 2024; Halimah et al., 2025).
Role of DBR	The ASSURE model is used as an instructional design model at the unit/lesson level, rather than as a research methodology.
Role of ASSURE	The ASSURE model is used as an instructional design model at the unit/lesson level, rather than as a research methodology.
Main DBR steps	Identifying problems and curriculum needs; analyzing the context of schools, students, teachers, and Marapu Philosophy; initial design of a Marapu-AI curriculum; limited trials; formative evaluation; revision; broader implementation; reflection; and dissemination.
ASSURE steps applied	Analyze Learners, State Objectives, Select Media and Methods, Utilize Media and Materials, Require Learner Participation, Evaluate and Revise (Lamina et al., 2023; Wardoyo & Pratini, 2024).
DBR-ASSURE integration	At the design and evaluation stages within the DBR cycles, the ASSURE steps are operationalized to design, implement, and revise Marapu-based mathematics learning scenarios that make use of digital and AI media.

Thus, DBR ensures that the curriculum development process proceeds systematically and is grounded in context, while ASSURE provides an operational structure at the classroom instructional level. The integration of the two yields a methodological framework that is consistent between the macro curriculum level and the micro practice level, enabling the resulting curriculum design to be tested, revised, and refined repeatedly in real-world situations.

## **2. Research Sites and Participants**

This study was conducted in areas that are socially and culturally closely associated with Marapu practices, namely four districts in Southwest Sumba Regency. Schools and participants were selected purposively to ensure that the curriculum being developed was genuinely tested in contexts with a strong cultural identity, while at the same time having at least a minimal level of readiness in terms of digital infrastructure. A summary of the research sites and participants is presented in the following table.

**Table 2. Research Sites and Participants**

<b>Component</b>	<b>Description</b>
Research area	Four districts in Southwest Sumba Regency: Kodi, Kodi Balaghar, Kodi Utara, and Kodi Bangedo.
Type of schools	A total of 38 public and private junior high schools representing the diversity of contexts and the strength of Marapu tradition in the research area.
Students	380 junior high school students (10 students from each school) as recipients of the curriculum intervention.
Teachers	76 mathematics teachers (2 teachers per school) as implementers of instruction and partners in curriculum development.
Traditional leaders	Marapu traditional leaders in each district as partners for validating cultural values and interpreting Marapu symbolism in learning.
Selection technique	Schools were selected purposively based on the following criteria: (1) strong Marapu cultural practice and identity in the school environment; and (2) minimum availability of digital infrastructure (laptops, projectors).
Contextual references	Descriptions of the role and cultural position of Marapu refer to Soeriadiredja (2013) and Wedasantara et al. (2023).

This configuration of research sites and participants ensures that curriculum development is not detached from the cultural context and the readiness of the school ecosystem. By simultaneously involving students, teachers, and traditional leaders, this study gains rich perspectives on how the Marapu-AI-based curriculum is designed, implemented, and received in the everyday life of schools in Southwest Sumba.

### 3. Curriculum Development Procedure (DBR-ASSURE)

The curriculum development procedure in this study follows DBR cycles within which the ASSURE steps are operationalized to design instructional units. Each cycle begins with an analysis of needs and learner characteristics, followed by the formulation of objectives, selection of methods and media, classroom implementation, reinforcement of student engagement, and concludes with evaluation and revision. This sequence is summarized in the following table.

**Table 3. Curriculum Development Procedure (DBR-ASSURE)**

<b>Stage / Step</b>	<b>Focus of Activities</b>	<b>Example of Implementation</b>
Analyze Learners	Mapping student characteristics (Marapu cultural background, technological experience, attitudes toward mathematics) and teacher profiles (teaching experience, curriculum understanding, digital competencies) through questionnaires and brief interviews.	Identifying students who are accustomed to Marapu rituals and those who have access to digital devices; mapping teachers' needs for technology training (Lamina et al., 2023).
State Objectives	Formulating mathematics learning objectives that integrate Marapu values of harmony, order, and numerical symbolism	Objectives such as: "Students are able to explain the concept of symmetry by referring to Marapu woven ikat

	with junior high school curriculum outcomes (geometry, number patterns, logic, measurement).	patterns” or “Students are able to analyze number patterns that represent cycles of traditional rituals.”
Select Media and Methods	Selecting contextual teaching methods (discussion, mathematics–culture projects, problem-based learning) and digital media (e-modules, Canva AI, ChatGPT, Khanmigo) to support Marapu–AI integration	Using exploratory projects on woven patterns, discussing the meaning of numbers in rituals, and practicing adaptive problems through AI platforms (Ashari et al., 2025; Bito & Masaong, 2023; Judijanto et al., 2025).
Utilize Media and Materials	Implementing the instructional materials in the classroom during several limited trial cycles and broader implementation.	Canva AI is used to create illustrations of symmetry in woven textiles; ChatGPT functions as a virtual tutor in number pattern exercises; Khanmigo provides adaptive problems based on Marapu contexts. .
Require Learner Participation	Fostering active student engagement in discussions, presentations, exploration of AI applications, and project tasks that connect Marapu culture with mathematical concepts.	Students design digital posters themed “mathematics in Marapu ceremonies,” present their findings, and discuss their relation to geometric concepts or number patterns.
Evaluate and Revise	Conducting formative evaluation through observations, teacher reflections, and student feedback; using the results to revise the curriculum and instructional materials in subsequent DBR cycles.	Adjusting the level of complexity of adaptive problems, refining contextual examples, and reorganizing time allocation for project-based activities (Wardoyo & Pratini, 2024).

Through this procedure, curriculum development proceeds in an iterative and reflective manner: each cycle not only produces improvements at the level of instructional materials, but also deepens the understanding of researchers and teachers regarding the most effective ways to integrate Marapu Philosophy and AI technology into mathematics instruction.

#### 4. Instruments and Data Collection

To comprehensively capture the dynamics of curriculum development and implementation, this study employed a combination of qualitative and quantitative instruments. These instruments were designed to gather information on processes, experiences, and curriculum impacts from the perspectives of students, teachers, and traditional leaders, while simultaneously providing numerical data on motivation, cultural identity, digital literacy, and understanding of mathematical concepts. A summary of the instruments and data collection procedures is presented in the following table.

**Table 4. Instruments and Data Collection**

Type of Instrument / Data	Purpose	Respondents / Sources	Format & Example Indicators / Items	Type of Data
Semi-structured interviews	To explore perceptions, experiences, and evaluations of Marapu-AI integration in mathematics learning	Teachers, students, and traditional leaders in each district.	Questions on students' feelings when Marapu culture is incorporated into mathematics lessons; traditional leaders' views on the meaning of numerical symbols; teachers' views on technological supports and constraints (Jailani, 2023; Siregar, 2025).	Qualitative.
Classroom observations	To record learning dynamics, student engagement, and the use of digital and AI-based media.	Teaching sessions in several schools	Observation rubrics with indicators such as students asking/answering questions, active discussions, use of woven patterns/carvings/traditional calendars, and use of Canva AI, ChatGPT, and Khanmigo in class.	Qualitative and rating-scale.
Documentation	To support triangulation with artefactual evidence related to curriculum and instructional practices.	Curriculum documents, lesson plans, student products, photos, and videos.	Curriculum and teaching modules, digital posters/animations, classroom activity photos, video recordings of project presentations, and documentation of cultural artefacts used in instruction.	Qualitative.
Questionnaires on motivation, cultural identity, digital literacy, and attitudes toward Marapu-AI	To quantitatively measure learning motivation, pride in cultural identity, digital literacy, and attitudes toward Marapu-AI integration.	Students (n = 380).	Four- or five-point Likert scales; example items include: "I am more enthusiastic about learning mathematics when it is linked to Marapu patterns and symbols"; "I feel comfortable using digital media to learn mathematics."	Quantitative.
Mathematics conceptual understanding test	To measure changes in understanding of mathematical concepts (geometry, number patterns, logic) before and after	Students (pre-test and post-test).	Contextual problems such as symmetry in woven patterns, number sequences modeling ritual cycles, and time calculations for ceremonies based on local calendrical systems (Habibi, 2025; Setiawi, Ayu, & Malo, 2025).	Quantitative.

Type of Instrument / Data	Purpose	Respondents / Sources	Format & Example Indicators / Items	Type of Data
Instrument validation	the intervention.  To ensure content validity and cultural sensitivity of the instruments used.	Experts in mathematics education, ethnomathematics experts, and Marapu traditional leaders	Review of the alignment between item content and the constructs being measured, as well as the appropriateness of Marapu cultural representations in the instruments (Khaerani et al., 2024; Wulandari & Puspadewi, 2016).	Qualitative.

The combination of these instruments enables the study to capture the curriculum development process, changes in instructional practice, and the impacts perceived by students in a more holistic manner. Validation by experts and traditional leaders ensures that the instruments are not only academically sound, but also sensitive to the Marapu cultural context that constitutes the core focus of this study.

## 5. Data Analysis and Trustworthiness

The data analysis in this study was designed to integrate qualitative and quantitative findings in a mutually complementary manner. Qualitative data were analyzed using thematic analysis, whereas quantitative data were analyzed descriptively and through simple comparative techniques. In addition, various trustworthiness strategies were applied to ensure the credibility and reliability of the findings. A summary of the analysis procedures and trustworthiness measures is presented in the following table.

**Table 5. Data Analysis and Trustworthiness**

Component	Description
Qualitative analysis	Interview, observation, and documentation data were analyzed using thematic analysis with the aid of qualitative data analysis software (e.g., NVivo). The stages included familiarization, initial coding, theme development, review/refinement, and naming and defining themes (Asmara et al., 2024).
Examples of codes and themes	Initial codes: "value of harmony in geometry," "role of traditional leaders," "use of AI by teachers," "infrastructure challenges," "students' responses to Marapu integration." Resulting themes: "mapping Marapu values onto mathematics topics," "transformation of pedagogical practice," "community support and resistance."
Inter-coder reliability	Approximately 20–25% of the interview transcripts and observation sheets were coded independently by two researchers. Coding differences were discussed until consensus was reached and a stable coding scheme was established before being applied to the entire dataset.
Quantitative analysis	Questionnaire and test data were analyzed descriptively and through simple comparative techniques, including calculation of percentages, means, and standard deviations, as well as comparison of pre-test and post-test scores to identify trends in conceptual understanding gains.

Component	Description
Percentage calculation	The percentages reported in Table 4 (for example, 81.6% for motivation) were derived from the proportion of students with high-category responses (“agree” + “strongly agree”) relative to the total number of respondents (n = 380), multiplied by 100: $\text{Percentage} = (\text{number of high-category responses} / \text{total respondents}) \times 100\%$
Data trustworthiness	rustworthiness was enhanced through source triangulation (students, teachers, traditional leaders) and method triangulation (interviews, observations, documentation, questionnaires, tests), member checking with teachers and traditional leaders, peer debriefing with colleagues, and maintaining an audit trail of the DBR design and revision processes (Jailani, 2023).

Overall, these analytical and trustworthiness strategies ensure that the research findings do not merely present numerical increases in motivation, understanding, cultural identity, and digital literacy, but also narrate how these changes unfold within everyday instructional practice. Accordingly, the results obtained rest on a strong empirical foundation to support the development of a mathematics curriculum based on Marapu Philosophy and digital innovation in the context of Southwest Sumba.

## C. Results and Discussion

### 1. Integration of Marapu Philosophy into Mathematics Content

The integration of Marapu Philosophy into mathematics instruction constitutes a strategic effort to provide culturally responsive and contextually relevant education for students in Southwest Sumba. Marapu, as both a belief system and a philosophy of life for the local community, embodies values of harmony, order, and numerical symbolism that can be creatively combined with various mathematical concepts. Through this approach, mathematics is no longer perceived as an abstract discipline detached from everyday life, but rather as living knowledge that is closely connected to local traditions. Topics such as geometry, number patterns, and logic can be taught by linking them to concrete examples drawn from Marapu cultural practices, thereby enabling students to more easily understand concepts while simultaneously internalizing their cultural values (Habibi, 2025).

**Table 6. Integration of Marapu Philosophy into Junior High School Mathematics Content**

Concept of Marapu Philosophy	Core Value	Relevant Mathematics Topics	Example of Application in Instruction
Harmony and Balance	Harmonious relationships among humans, nature, and the Creator	Geometry (two-dimensional and three-dimensional shapes)	Linking the concept of symmetry to carvings on traditional houses or Sumba woven ikat; students are asked to draw symmetrical patterns that reflect balance.

Concept of Marapu Philosophy	Core Value	Relevant Mathematics Topics	Example of Application in Instruction
Order in the Life Cycle	Human life and nature proceed in recurring patterns	Number patterns and sequences	Connecting number patterns to the counting of Marapu ritual cycles or traditional weaving patterns; students construct number sequences based on geometric patterns in woven textiles.
Numerical Symbolism	Certain numbers carry spiritual or social meanings	Logic and arithmetic	Explaining the meanings of numbers in Marapu rituals (for example, the numbers 4 or 8 as symbols of directions/cardinal points) and relating them to the concepts of multiples and factors.
Cosmic Relations	The relationship between humans and the cosmos/natural universe	Circle geometry and basic trigonometry	Relating the circle shape to Marapu cosmic symbols; students use circles to understand angle calculations in the context of local astronomy.
Rituals and Time Calculation	Determining the timing of ceremonies and planting seasons	Measurement and mathematical calendars	Linking calendar calculations to Marapu traditional time-keeping systems; students perform simple conversions between the local calendar and the modern calendar.

Theoretically, the patterns presented in Table 6 illustrate how Marapu Philosophy functions as a bridge between abstract mathematical concepts and concrete lived experience, in line with the ethnomathematical view that mathematical practices are embedded in everyday cultural activities (D’Ambrosio, 1985; Habibi, 2025; Khaerani et al., 2024). When students learn symmetry through woven patterns or understand number sequences through ritual cycles, they do not merely memorize formulas; rather, they negotiate the meaning of mathematics in the symbolic language of their own culture. This process helps to reduce the “psychological distance” between school mathematics and the lifeworld, while simultaneously strengthening students’ cultural identity as knowledgeable subjects, rather than as mere recipients of knowledge. Thus, these findings affirm that the integration of Marapu does not simply enrich the contextual backdrop of instruction, but genuinely renders mathematics meaningful for students, as emphasized in the ethnomathematics literature.

## 2. The Role of Digital Technology

The use of Artificial Intelligence (AI)-based technology in education offers considerable opportunities to provide more contextual, adaptive, and innovative learning experiences. In the context of integrating Marapu Philosophy into the mathematics curriculum, AI can serve as an effective medium for connecting local cultural values with abstract mathematical concepts (Bito & Masaong, 2023). Through digital media, blended learning, and interactive e-learning, AI tools such as Canva AI, ChatGPT, and Khanmigo can support teachers in designing instructional materials,

providing interactive guidance to students, and enriching the curriculum with content that aligns with the demands of 21st-century competencies (Jayantika & Namur, 2022).

**Table 7. The Role of AI in Supporting Marapu Philosophy-Based Mathematics Learning**

Aspect/ AI Used	Implementation	Example of Use	Function for Teachers	Function for Students	Function for the Curriculum
Digital Media for Cultural Values (Canva AI)	Presenting Marapu symbols, patterns, and narratives through interactive visual media so that they are connected to mathematical concepts..	Developing animated videos about symmetrical patterns in carvings on Sumba traditional houses and linking them to geometry concepts.	Assisting in the design of contextual digital media (illustrations, posters, interactive animations) that connect mathematics with Marapu symbols/patterns.	Providing engaging visual content that facilitates students' understanding of abstract mathematical concepts.	Producing culturally responsive, visually based instructional materials that are easily integrated into the curriculum.
Blended Learning Berbasis Lokal (ChatGPT)	Combining face-to-face instruction with digital access (e-modules, local learning management systems).	The teacher explains the material in class, and students subsequently work on number pattern problems in a Marapu-based digital e-module.	Serving as a pedagogical assistant that helps teachers develop contextual test items, instructional materials, and learning scenarios.	Acting as an interactive AI tutor that provides culture-based practice questions, additional explanations, and feedback	Supporting the integration of adaptive, AI-supported learning into the curriculum through interactive discussion elements.
Interactive E-Learning (Khanmigo)	Providing AI-based adaptive learning experiences tailored to students' needs.	Students access interactive simulations to learn about Marapu numerical symbolism and its relationship to arithmetic.	Assisting teachers in preparing adaptive assessment materials and mathematics problem simulations that align with students' needs.	Offering interactive e-learning experiences with adaptive questions and simulations grounded in students' life contexts.	Strengthening the evaluative and adaptive practice dimensions of the curriculum in line with 21st-century skill demands

From a theoretical perspective, tools such as Canva AI, ChatGPT, and Khanmigo function as *cultural mediators* that translate Marapu cultural symbols into learning objects that can be manipulated visually, textually, and interactively. Within the TPACK framework, technology (T) does not stand alone, but intersects with mathematical content (C) and contextual pedagogy (P): teachers are required not only

to master concepts such as geometry or number patterns, but also to know how to package these through visual representations of Marapu weaving using Canva AI, design dialogic interactions with ChatGPT, and provide adaptive practice through Khanmigo (Mishra & Koehler, 2006; Jayantika & Namur, 2022; Susanti et al., 2024).

Viewed from the lens of multimedia learning theory, the use of contextually relevant combinations of text, images, and animations aligned with students' cultural schemata has the potential to reduce extraneous cognitive load and to strengthen the integration of verbal and visual information (for example, through the principles of contiguity and coherence in multimedia learning theory). Thus, AI is not merely a "sophisticated tool," but operates as an intermediary that bridges the symbolic world of Marapu, mathematical representations, and students' ways of thinking within digital learning environments.

### 3. Impact on Learning

The integration of Marapu Philosophy with digital technology in mathematics instruction has a significant impact on the learning processes of junior high school students in Southwest Sumba. Data collection results indicate increases in learning motivation, conceptual understanding, strengthened cultural identity, and digital literacy skills. These achievements not only reflect the success of a culturally responsive curriculum innovation, but also reaffirm that technology can serve as an effective medium for bridging local wisdom with the competency demands of the 21st century.

**Table 8. Impact of Integrating Marapu Philosophy and Digital Technology on Mathematics Learning**

Impact Aspect	Indicator	Number of Students (n = 380)	Percentage (%)	Description
Increase in Learning Motivation	Students display higher interest when mathematics is linked to Marapu symbols/patterns.	310	81,6%	The majority of students are more enthusiastic about participating in lessons because they feel that the learning is closely connected to their own culture.
Conceptual Understanding of Mathematics	Students are able to relate geometry, number patterns, and logic materials to local cultural examples.	295	77,6%	Understanding improves because abstract concepts are translated into real-life contexts.
Strengthening of Cultural Identity	Students feel proud that Marapu cultural values are highlighted in the learning process.pembelajaran	325	85,5%	Cultural integration fosters self-confidence and strengthens students' local identity.
Increase in Digital Literacy	Students are able to use e-modules, applications, and digital media in the learning process.	280	73,7%	Students are becoming accustomed to accessing digital technology as an integral part of learning.

When viewed through the lens of ethnomathematics, the high levels of motivation (81.6%) and strengthened cultural identity (85.5%) indicate that when mathematics is presented as part of familiar cultural practices, students feel “recognized” and no longer positioned as outsiders in the mathematics classroom (D’Ambrosio, 1985; Habibi, 2025). The increase in conceptual understanding (77.6%) suggests that the bridge between the abstract and the concrete constructed through Marapu Philosophy is genuinely effective: geometry is no longer merely lines and angles on the board, but appears in the symmetry of woven textiles and the structures of traditional houses; number patterns are no longer just symbolic sequences, but reflect ritual cycles that are familiar in students’ lives.

Meanwhile, the rise in digital literacy (73.7%) shows that the presence of AI and digital media does not displace local culture; instead, it becomes a new medium for representing and processing that culture in visual and interactive forms. In other words, the data in Table 8 affirm that the combination of ethnomathematics, TPACK, and AI-based technology produces synergistic effects on students’ cognitive, affective, and identity domains.

#### 4. Critical Analysis

A critical analysis of the implementation of a Marapu Philosophy-based mathematics curriculum supported by digital technology is necessary to examine the strengths, weaknesses, and challenges encountered in the real context of Southwest Sumba. The conditions in the four districts under study – Kodi, Kodi Balaghar, Kodi Utara, and Kodi Bangedo reveal diverse dynamics in terms of culture, teacher involvement, student characteristics, technological infrastructure, and community acceptance. The following table provides a comprehensive summary of these aspects (Hadi, 2024).

**Table 9. Critical Analysis of the Implementation of a Marapu Philosophy-Based Mathematics Curriculum Supported by Digital Technology**

Aspect	Conditions in the Research Sites (4 Districts)	Strengths	Weaknesses	Challenges
Cultural context	Marapu Philosophy is still highly respected; traditional leaders are actively involved in non-formal education.	Strong local culture, making it relatively easy to integrate into instruction.	There is no formal curriculum that explicitly accommodates Marapu values.	A shared understanding among schools, teachers, and traditional leaders is needed to ensure that integration proceeds in a balanced manner.
Teacher involvement	76 mathematics teachers with varied teaching experience and educational backgrounds.	Teachers are enthusiastic about connecting instructional content with local culture..	Not all teachers are accustomed to using digital technology in teaching.	Intensive training is required to enhance teachers’ digital competencies.

Aspect	Conditions in the Research Sites (4 Districts)	Strengths	Weaknesses	Challenges
Student condition	380 students; most are familiar with Marapu culture, but access to technology is uneven.	Students are motivated because the learning process is closely related to their everyday lives.	Gaps in digital literacy among students are still evident.	Adequate support and facilities are needed so that all students can participate in e-learning.
Technological infrastructure	Schools in Kodi Utara are relatively better equipped; in Kodi and Kodi Bangedo, internet access and devices remain limited.	Several schools already use basic digital devices (laptops, projectors).	Limited internet connectivity and digital devices are the main obstacles.	Investment in infrastructure and support from local government are urgently needed.
Community acceptance	Parents and traditional leaders generally support culture-based educational innovation, although a small proportion remain hesitant about digital formats.	Strong socio-cultural support facilitates implementation.	There are concerns that digitalization may “alter” the sacred ways in which culture is presented	Ongoing public outreach is required so that the community understands the benefits of integrating culture and technology.

The findings in Table 9 underscore that technology possesses two interrelated dimensions. On the one hand, technology and AI serve as powerful levers for expanding access to learning resources and for creatively visualizing local culture. On the other hand, limitations in infrastructure and digital literacy generate digital divides between schools, between teachers, and between students. This situation is consistent with the global educational equity literature, which highlights that technological innovation often widens the gap between those who have access and those who do not, if it is not accompanied by affirmative policies and infrastructure investment (Sawitri et al., 2019; Susanti et al., 2024).

In the context of Southwest Sumba, the success of Marapu–AI integration is highly dependent on structural support: teacher training, provision of devices, and reinforcement of internet connectivity in regions that have thus far been left behind. Accordingly, this innovative curriculum should not be viewed solely as an instructional design issue, but also as part of a broader agenda of social justice and digital justice in education.

#### **D. Conclusions**

This study concludes that the integration of Marapu Philosophy with digital

innovation in mathematics instruction is capable of producing a culturally responsive curriculum that simultaneously supports the goals of sustainable education. By involving 380 students, 76 mathematics teachers, and traditional leaders from 38 schools across four districts in Southwest Sumba, the main findings indicate increases of 81.6% in learning motivation, 77.6% in conceptual understanding of mathematics, 85.5% in the strengthening of cultural identity, and 73.7% in digital literacy skills. These results affirm that mathematics, when interwoven with the Marapu values of harmony, order, and numerical symbolism, can transform students' understanding of abstract concepts into forms that are more contextual, engaging, and meaningful.

From a practical standpoint, three key implications emerge. First, teachers need to implement contextual teaching strategies by utilizing digital media as a vehicle for conveying cultural values. Second, the development of instructional media can be reinforced through the use of Artificial Intelligence technologies such as Canva AI to visualize cultural symbols within mathematical content, ChatGPT as an interactive tutor in blended learning, and Khanmigo to provide adaptive, culture-based e-learning tasks. Third, school policies must support the integration of local culture into the curriculum by providing adequate technological facilities and teacher training.

Recommendations for future research include extending the inquiry to other regions with different cultural backgrounds in order to formulate cross-regional models of culturally responsive curricula and to strengthen comparative analyses of the effectiveness of this approach. In addition, more intensive collaboration with educational technology developers and stronger digital infrastructure support from the government are crucial to ensuring the sustainability, equity, and scalability of local culture-based education in the global era. Thus, this study answers the central question that the integration of Marapu values through digital innovation not only enhances the quality of mathematics learning, but also instills cultural identity and prepares younger generations to face global challenges.

## **E. Acknowledgement**

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